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NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY, GREATER NOIDA
(An Autonomous Institute Affiliated to AKTU, Lucknow)

B.Tech

SEM: III - THEORY EXAMINATION (2025 - 2026)

Subject: Analytical Techniques

Time: 3 Hours

Max. Marks: 100

General Instructions:

IMP: Verify that you have received the question paper with the correct course, code, branch etc.

1. This Question paper comprises of **three Sections -A, B, & C**. It consists of Multiple Choice Questions (MCQ's) & Subjective type questions.

2. Maximum marks for each question are indicated on right -hand side of each question.

3. Illustrate your answers with neat sketches wherever necessary.

4. Assume suitable data if necessary.

5. Preferably, write the answers in sequential order.

6. No sheet should be left blank. Any written material after a blank sheet will not be evaluated/checked.

SECTION-A

20

1. Attempt all parts:-

- 1-a. Which part of the compound microscope helps in gathering and focusing light rays on the specimen to be viewed? (CO1, K1) 1
- (a) Eyepiece lens
- (b) Objective lens
- (c) Condenser lens
- (d) Magnifying lens
- 1-b. The biological materials have little intrinsic capability to _____ (CO1, K1) 1
- (a) Absorb light
- (b) Reflect sound
- (c) Scatter electrons
- (d) Reflect light
- 1-c. Ion exchange chromatography is based on the _____ (CO2, K1) 1
- (a) Electrostatic attraction
- (b) Electrical mobility of ionic species
- (c) Adsorption chromatography
- (d) Partition chromatography
- 1-d. In reverse phase chromatography, the stationary phase is made (CO2, K1) 1
- (a) Non-polar
- (b) Polar
- (c) Either non-polar or polar
- (d) None of these

- 1-e. Which region has the longest wavelength? (CO3, K1) 1
- (a) Gamma rays
 - (b) Ultraviolet
 - (c) Radio waves
 - (d) X-rays
- 1-f. Spectroscopy deals with the study of? (CO3, K1) 1
- (a) Matter-motion
 - (b) Light-matter interaction
 - (c) Chemical reactions
 - (d) Electric conductivity
- 1-g. For the separation of DNA by electrophoresis, which of the following method is commonly used? (CO4, K1) 1
- (a) Agarose – vertical
 - (b) Agarose – horizontal
 - (c) PAGE – vertical
 - (d) PAGE – horizontal
- 1-h. If proteins are separated according to their electrophoretic mobility then the type of electrophoresis is: (CO4, K1) 1
- (a) SDS PAGE
 - (b) Affinity Electrophoresis
 - (c) Electro focusing
 - (d) Free flow electrophoresis
- 1-i. What is the principle of centrifugation? (CO5, K1) 1
- (a) Size reduction principle
 - (b) Filtration principle
 - (c) Evaporation principle
 - (d) Sedimentation principle
- 1-j. The particles that settle out from the suspension become sediment, and in water treatment is known as? (CO5, K1) 1
- (a) Sediment
 - (b) Thickening
 - (c) Sludge
 - (d) Consolidation

2. Attempt all parts:-

- 2.a. What is the purpose of oil immersion in light microscopy? (CO1, K1) 2
- 2.b. Define retention factor (Rf) in chromatography? (CO2, K1) 2
- 2.c. Why is flame used in atomic absorption spectroscopy? (CO3, K1) 2
- 2.d. Why is staining necessary after electrophoresis? (CO4, K1) 2
- 2.e. What type of rotor is commonly used in ultracentrifugation? (CO5, K1) 2

SECTION-B

30

3. Attempt all parts:-
- 3.a. Answer any one of the following:-
- 3.a.(i) Explain the working of dark field microscopy with the role of special condenser? (CO1, K2) 6
- 3.a.(ii) Describe the main applications of TEM, SEM, and AFM in biological and material sciences? (CO1, K2, K3) 6
- 3.b. Answer any one of the following:-
- 3.b.(i) A mixture shows poor separation in column chromatography. Suggest at least two modifications to improve separation? (CO2, K2) 6
- 3.b.(ii) Explain the principle, working, and one application of gas liquid chromatography? (CO2, K2) 6
- 3.c. Answer any one of the following:-
- 3.c.(i) Describe the concept of chromophores and how they influence UV-VIS absorption? (CO3, K1) 6
- 3.c.(ii) Explain the relationship between wavelength, frequency, and energy of electromagnetic radiation and discuss the significance of different regions of the electromagnetic spectrum in spectroscopy? (CO3, K2) 6
- 3.d. Answer any one of the following:-
- 3.d.(i) Discuss how gel concentration and pore size influence separation efficiency? (CO4, K2) 6
- 3.d.(ii) Discuss how 2D electrophoresis (IEF + SDS-PAGE) improves protein separation in complex mixtures? (CO4, K2) 6
- 3.e. Answer any one of the following:-
- 3.e.(i) Demonstrate an experiment using an ultracentrifuge to separate proteins based on molecular weight? (CO5, K2) 6
- 3.e.(ii) Discuss how sucrose or CsCl gradients help in improving the resolution of particle separation? (CO5, K2) 6

SECTION-C

50

4. Answer any one of the following:-
- 4-a. Compare TEM and SEM in terms of image type, resolution, and specimen preparation? (CO1, K2) 10
- 4-b. Draw a well labeled diagram of a compound light microscope and explain the function of each part? (CO1, K1, K2) 10
5. Answer any one of the following:-
- 5-a. Two compounds have the same R_f value in one solvent. Suggest steps to separate them and explain your reasoning? (CO2, K2) 10
- 5-b. Explain how elution in ion exchange chromatography can be controlled using pH and ionic strength? (CO2, K2) 10
6. Answer any one of the following:-
- 6-a. Describe the significance of chemical shift, spin-spin coupling, and integration in NMR spectroscopy? (CO3, K1) 10
- 6-b. Demonstrate a laboratory experiment to measure protein concentration using UV- 10

VIS spectroscopy. Explain the procedure, selection of wavelength, and how you would interpret the results? (CO3, K2)

7. Answer any one of the following:-

7-a. Explain the importance of controlling voltage and temperature during electrophoresis for accurate separation? (CO4, K2) 10

7-b. Explain how gel electrophoresis can be used to separate and analyze complex mixtures of proteins or nucleic acids? (CO4, K2) 10

8. Answer any one of the following:-

8-a. Outline a workflow combining centrifugation with SDS-PAGE and Western blotting to analyze cellular proteins? (CO5, K2) 10

8-b. Discuss the role of centrifugation in isolating organelles from plant cells, including chloroplasts and mitochondria, and how purity is assessed? (CO5, K2) 10

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